WATER QUALITY

A Report of Progress

USDA

U.S. Department of Agriculture Water Quality: A Report of Progress

Preface

During this century, advances in agricultural science and technology have profoundly affected our standard of living and way of life. Agricultural chemicals are an important component of these advances. They contribute substantially to the productivity and efficiency of agriculture and to the well-being of rural and urban communities. Even so, many people are concerned about the possible risks to human health, water quality, and a safe environment resulting from the use of these chemicals. Better methods of detecting minuscule amounts of chemicals in water have alerted us to the need to be more judicious in their use and more careful in their management.

The U.S. Department of Agriculture is committed to ensuring that this Nation meets the challenge of maintaining the efficiency and productivity of agriculture without compromising the quality of our water resources or the safety of our environment. Many farmers view their relationship with natural resources as one of stewardship. This partnership, however, requires knowledge about environmental problems, such as water contamination, and the adoption of appropriate practices to enhance or protect water quality.

The preservation and enhancement of water quality in agricultural areas calls for the timely delivery of research, educational materials, conservation technology, and financial assistance. The USDA strongly encourages voluntary actions to protect and conserve water resources. To assist land users with soil and water resource problems, USDA offers a strong institutional framework, and an established network of researchers, technical and financial assistance specialists, economists, and educators.

USDA has coordinated its Water Quality Program with other Federal agencies to provide assistance to State and local governments, and to the landowner; to improve its data bases; and to focus its efforts to better assess and address water quality problems.

This report summarizes USDA achievements for developing the scientific, educational, technical and financial assistance, data base, and evaluation needed to enhance and maintain the quality of our Nation's water resources. It is based on the program achievements of the Agricultural Research Service, Cooperative State Research, Education, and Extension Service, Farm Service Agency, Economic Research Service, National Agricultural Statistics Service, Natural Resources Conservation Service, and National Agricultural Library.

USDA's Water Quality Program, and its Working Group on Water Quality (WGWQ), provide mechanisms to respond to both continuing and new challenges. The WGWQ provides a focus for departmental perspectives; for communicating with partners from both the agricultural and environmental communities; to provide insight from both communities; and to facilitate the search for mutually acceptable solutions. The WGWQ's very existence is a powerful message to both communities that USDA is aware of, and concerned about, the need to protect water quality without unnecessarily handicapping American farmers in the global marketplace.

Table of Contents

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Background

The U.S. Department of Agriculture (USDA) Water Quality Program established environmental quality as a priority in the Department.

Principles:

• The Nation's water resources must be protected from contamination by fertilizers and pesticides without jeopardizing the economic vitality of U.S. agriculture

• Water quality programs must accommodate the immediate need to halt contamination and the future need to alter farm production practices

• Ultimately, farmers must be responsible for changing production practices to avoid contaminating water resources

Goal

Farmers and ranchers will have the knowledge, technical means, and financial assistance to respond independently and voluntarily in addressing farm-related environmental concerns and related State water quality requirements.

Objectives and related activities:

Three objectives were established to assist in reaching the goal. For each of these, a series of results-oriented activities were identified. While there is some obvious overlap, the activities are most closely related to the objectives in the following way(s).

Objective:

To determine the relationships between agricultural activities and water quality

Activities:

• Develop methods for sampling, measuring, and evaluating groundwater contamination

• Conduct research to provide the basis for improved management of chemicals used in agriculture

• Improve agrichemical management and agricultural production systems

• Evaluate the economic, social, technical and environmental impacts of new and improved management practices and systems

Objective:

To develop agricultural production systems that enhance or protect water quality

Activities:

• Build National and State data bases on agrichemical use and related farm practices

• Develop mathematical models to assist in State and Federal evaluation of alternative policies and program strategies

• Improve agrichemical management and agricultural production systems

• Evaluate the economic, social, technical and environmental impacts of improved management practices and systems

Objective:

To induce farmer's voluntary adoption of enhancement strategies at significant levels in problem areas

Activities:

• Improve State and staff capacity to deliver assistance to producers for agrichemical and waste product management, and for environmental stewardship

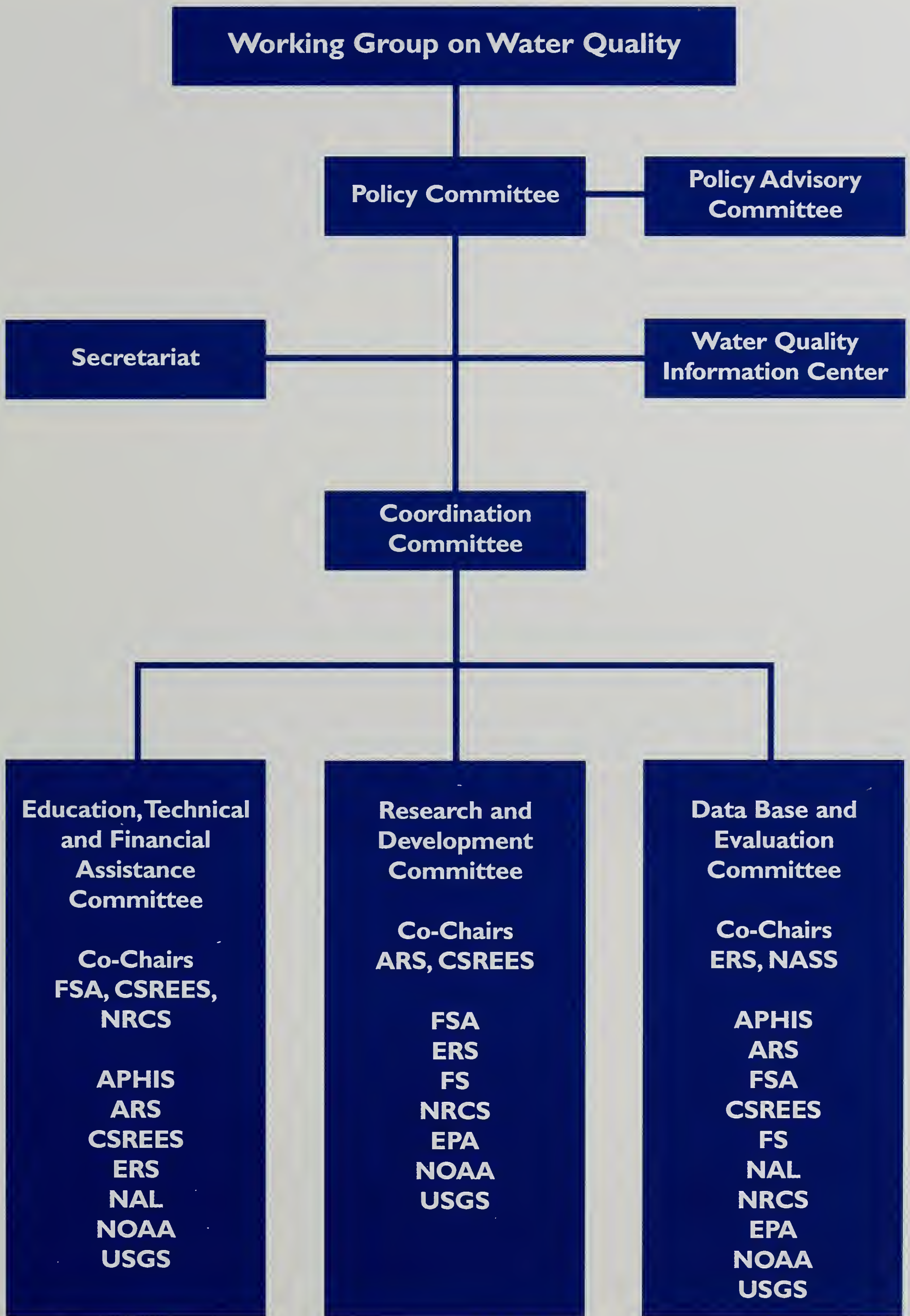
• Deliver technologies and management systems for voluntary adoption and implementation by farmers, ranchers, and foresters

• Provide financial assistance to accelerate the installation of measures to improve water quality

• Assist in meeting State water quality requirements through education and technical assistance

• Inform the public of program activities and achievements

The U.S. Department of Agriculture (USDA) has moved vigorously to reduce agricultural nonpoint sources of water impairments. USDA programs have aggressively encouraged farmers to develop and implement voluntary practices to reduce agricultural nonpoint source (NPS) pollution. The effort has resulted in dramatic reductions in the use of agricultural chemicals in designated project areas, without major decreases in crop yield levels, and in greatly reduced loadings to the environment.


Working Group on Water Quality
Policy Committee
Policy Advisory Committee
Secretariat
Water Quality Information Center
Coordination Committee
Education, Technical and Financial Assistance Committee
Co-Chairs
FSA, CSREES, NRCS
APHIS
ARS
CSREES
ERS
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Research and Development Committee
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NOAA
USGS
Data Base and Evaluation Committee
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AGRICULTURAL NONPOINT SOURCE CONTAMINATION: HOW USDA IS ADDRESSING THE PROBLEM

INTRODUCTION

Our Nation has made tremendous progress in addressing the various aspects of water pollution. As a result of the Clean Water Act, industrial discharges have been controlled by permits; raw sewage discharges have been reduced by the construction of sewage treatment plants; and phosphorus discharges have been greatly reduced by a combination of technology, education and laws (e.g., the widespread banning of phosphorus-based detergents). Because of such efforts, Lake Erie (once proclaimed "dead") has been resurrected, the Cuyahoga River (which once caught fire) has been rendered non-flammable, and many major rivers have improved water quality.

We have not dealt with all of the problems, of course; combined sewer overflows still occur in over 1,000 communities. The high costs of remediation preclude programs to deal with the problem. Fiscal reality overshadows the problem, and its expensive solutions.

"Biosolids" disposal also presents some challenges. Many disposal schemes disregard the nitrogen content,while agriculture is being "encouraged" to control the application of fertilizers and animal manures to reduce the environmental impacts of excess nitrogen.

This nation has implemented one of the world's best, most aggressive, most progressive water pollution control programs; it is not unreasonable to ask ourselves what more we want, how much more we can afford, and how it should be spent. We have made significant progress; the remaining problems are the tough (i.e., expensive) ones.

The restoration of the chemical and biological integrity of the Nation's waters is an elusive goal, complicated by the lack of documentation of the sources and extent of the impairment, on the one hand; and the lack of specification of achievable and realistic levels of remediation in chemical, biological or ecological terms, on the other.

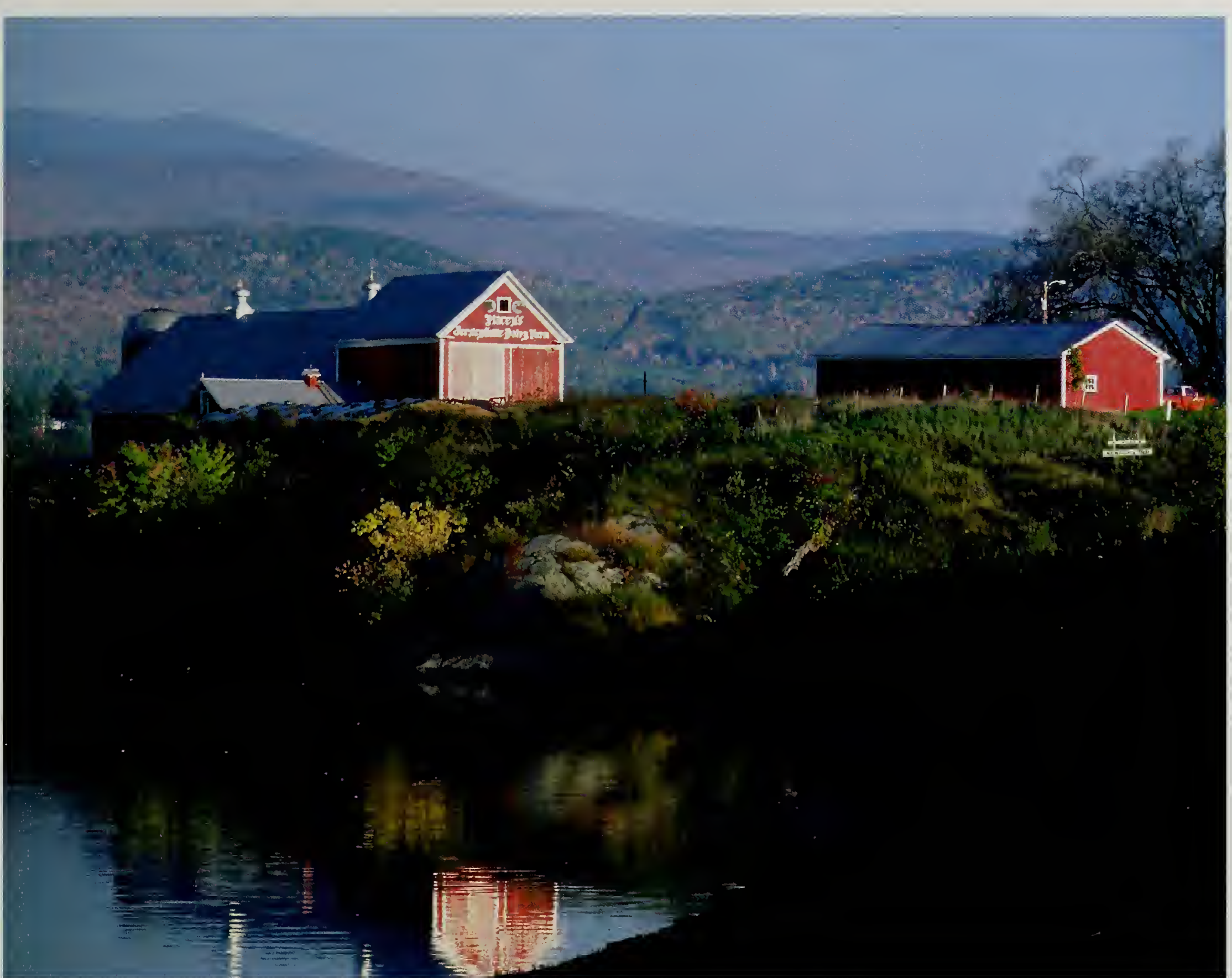
Such a lack of information data has been identified as a key barrier to State and local efforts to control nonpoint source pollution. There are few credible data on the scope and impacts of nonpoint source pollution, or on the effectiveness of potential solutions.

Human activity contributes to the degradation of water resources, but the actual extent is unknown. Such a lack of information facilitates generic pronouncements, which cannot be addressed. The Federal and State governments, and their component Departments and agencies, must be concerned with practical solutions to identified site-specific problems. Cities, industries, farmers, ranchers and other landowners may be convinced to alleviate identified nonpoint source (NPS) problems, but they are hesitant to invest in unspecified, or untried, solutions to generic problems.

Given this situation, some important questions should be addressed:

- What are the remaining water quality problems?
- Which are the most important in terms of environmental impact?
- How should we address them in a realistic manner?

These questions are relevant to everyone who makes or implements water quality policy. A pragmatic approach must recognize both that there are problems, and that they are being addressed. Many States are conducting successful interagency programs to address agricultural NPS pollution. More could always be done, given the necessary resources and policy direction. The difficulty lies in the reality that resources are in short supply, and that unfunded mandates have become a rallying point among those who must spend real dollars to solve real problems.



PROBLEMS

Some sectors of the public and their governmental representatives perceive the existence of an acute, widespread, water-quality-associated health crisis that stems from widespread water pollution, and that is threatening public health and welfare. This perception persists without the benefit of any supporting data.

EPA estimates that about one-third of our assessed surface waters do not meet designated uses, and that agriculture is the source of 60 percent of this impairment, largely from diffuse or NPS problems. These estimates are applicable only to the assessed one-third of our surface waters; these data do not constitute a representative sample of the Nation's waters; and, according to the EPA, "States are generally constrained by diminishing resources and competing needs to monitor most often on those waters with known or suspected problems."

EPA's national "Pesticides in Groundwater Survey" provided data, reliable on a national scale, that indicate the absence of any massive national problem. Pesticides are likely to be detected in only 4 percent of our water wells; the likelihood is somewhat higher in rural wells than in urban ones; and nitrate contamination is more widespread.

The "detection" of chemicals in water does not imply anything about health effects or legal limits; detection levels are usually well below such effect levels, and the disparity among these levels is sure to increase as our detection capabilities develop. The survey also reported a number of "statistical associations" between water contaminants and human health prob-

lems, but pointed out that such associations do not establish any cause-and-effect relationships.

A high level of potential vulnerability requires, among other factors, substantial rainfall in excess of evaporative demand, readily permeable soils, and substantial use of agricultural chemicals. The real differences in these parameters among (and even within) States makes any national synthesis a highly dubious basis for defining policy or program needs.

The USDA Water Quality Program identified the Cornbelt area as a major research focus in its "Management System Evaluation Area" projects, based on the widespread use of agricultural chemicals in the area; on the predominance of cropland; (implicitly) on an excess of precipitation to move agricultural chemicals into water resources; and on Congressional concerns about the contamination of groundwater by agricultural chemicals in the Corn Belt.

PROGRAMS

The USDA has long been at the forefront of programs to control soil erosion and associated sediment problems. The Soil Conservation Service was established in 1934 (now the Natural Resources Conservation Service), and has delivered technical assistance to reduce on-farm soil erosion and its off-farm effects.

The USDA and its State cooperators have developed and implemented a number of programs to address matters of agricultural contamination from both point and nonpoint sources. In the 1970's, considerable research emphasis was placed on the point-source aspects of the treatment and handling of animal wastes, and the influence of agriculture on water contamination. This resulted in many new handling and treatment processes.

Federal programs to address agricultural NPS pollution began with the joint USDA-EPA Model Implementation Program, in 1977. It funded NPS projects in seven States to demonstrate interagency cooperation, accelerated farmer adoption of Best Management Practices (BMP's), and the effects of those BMP's on water quality. Interagency cooperation was achieved, and farmer adoption of BMPs was significantly accelerated over the life of the projects; water quality impacts were, and are, the most difficult to document.

In the early 1980's, USDA's experimental Rural Clean Water Program established projects in 21 States, with funding of $70 million for the 10-year program. Significant adoption of BMP's occurred in all of the areas; some were reflected in improved water quality. These projects were successful in stimulating the farmers' adoption of specified BMP's, and in demonstrating the effectiveness of deliberate programs to stimulate such adoption.

But farmers' adoption of pragmatic BMP's is not always reflected in short-term changes in water quality. For example, 10 years of BMP adoption covering 74 percent of critical acres resulted in no significant reduction in nutrient loads in either tributary streams or in St. Albans Bay, Lake Champlain, VT. Reducing nutrient exports may take many years, depending on the amount of input reduction, and on initial field concentrations.

In the late 1980's, there was considerable concern in the Congress about the contamination of groundwater by agricultural chemicals, and the need for efforts to protect against such contamination. The resulting USDA Water Quality Program is based on the following guiding principles:

• The Nation's water resources must be protected from pollution by fertilizer and pesticides without jeopardizing the economic viability of U.S. agriculture.

• Pollution must be halted; and more environmentally benign farm production practices must be instituted.

• Farmers must be responsible for changing production practices to avoid polluting water resources.

Since the program was launched in 1990, the USDA — through its participating agencies — has instituted:

• Management Systems Evaluation Area (MSEA) projects in five Midwestern States, representing the Corn

Belt, designed to evaluate current production systems, to develop new ones, and to transfer the information to farmers;

• Sixteen (16) Demonstration projects, to accelerate the transfer of research results to farmer adoption;

• Seventy-four (74) Hydrologic Unit Area projects, to accelerate the application of BMP's in identified critical hydrologic units;

• Seventy-one (71) Water Quality Special projects, designed to accelerate adoption of improved management practices, especially through cost-share programs;

• Fifty-nine (59) in-house research projects to assist the MSEA efforts, and to increase understanding of the movement and fate of agricultural chemicals in the environment;

• Ninety (90) cooperative research projects, in which University researchers are investigating various aspects of agricultural chemical management, movement and fate.

• One hundred and seventeen (117) Water Quality Incentives Program projects.

These have been conducted in collaboration with the U.S. Geological Survey, EPA, State water quality agencies, and units of State and county government. Protocols have been established to involve a wide array of local, State, and Federal inputs to the selection of such projects, and to assure that they reflect State and local priorities for enhancing or protecting water quality.

PROGRESS

The USDA and its State cooperators are achieving results; but there are no credible water quality data against which these results can be evaluated. Most USDA program results must be reported in terms of "surrogate parameters," rather than in terms of water quality improvements. The USDA role is one of encouraging and assisting farmers to adopt management practices and systems that should enhance or protect water quality. Since the connections between NPS pollution and the quality of the receiving waters remain diffuse, the impacts of agricultural programs must be estimated by recording the extent of farmer adoption of such practices.

These cooperative projects are producing significant results. Through FY 1991, they resulted in the adoption of water quality practices by 10,000 producers on 552,000 acres of farmland; and reduced applications of nitrogen by 2.7 million pounds, phosphorus by 1.7 million pounds, and pesticide applications by 239,000 pounds. In addition, over 9,000 people received water quality training in FY 1990-92, including more than 4,000 people from non-USDA agencies. These projects have since gathered momentum, and the accomplishment numbers are expected to increase substantially.

The USDA has responded to the results of EPA's National Pesticide Survey, which indicated some potential problems of nitrate in groundwater. In 1992, USDA allocated some $700,000 for research on analyses for and management of nitrogen from soils, manures, and fertilizers. We have also encouraged our State staffs and counterparts to address the complex, field and crop-specific management practices for nitrogen management.

The "Pre-Sidedress Nitrogen Test" (PSNT) for rapid, on-site assessments of the status of plant nitrogen in corn, and its use by farmers from Vermont to Iowa, is reducing the application of excess nitrogen fertilizers in corn production. While the procedure is being used on only a small proportion of the total corn acreage, and while PSNT is not universally applicable to corn growing areas, it is an indicator of the kinds of technology that will likely reduce nitrogen loadings to water resources.

Position papers on nitrate fertilizers and on the extent of the nitrate contamination of groundwater have been developed. These have been widely distributed, to help agency personnel and farmers understand that there are identified areas where nitrate contamination of water is a problem. (Conversely, these papers help policy makers understand that it is not an ubiquitous national problem.)

The Management Systems Evaluation Area (MSEA) program has found that modifications in tillage herbicide and nitrogen management practices in a corn-soybean rotation system will lead to improved surface and groundwater quality and more profitable systems. For example, use of ridge tillage with accompanying banding of herbicide in the row with sidedress nitrogen appears to reduce negative effects on groundwater quality. As a guide to supplemental nitrogen applications, the chlorophyll meter shows promise for reducing leaching in irrigated corn production.

The MSEA program has shown that increasing surface residue cover and the soil organic content appears to increase degradation rates of herbicides. Management of weed populations through scouting and proper selection of postemergence herbicides can reduce movement to groundwater and surface water. Mapping of yields along with the nutrient availability and other soil productivity factors within fields can provide the information for precision inputs of fertilizers and herbicides.

The USDA also has conducted a separate Conservation Reserve Program (CRP), which has retired some 35 million acres of highly erodible lands from crop production. Grasses have been planted on 28 million of these acres, trees on 2 million acres, and the remaining 5 million acres have been converted to windbreaks, filter strips, and wildlife and wetland areas. These conversions will reduce sediment loadings to surface waters by 210 million tons per year, phosphorus loadings by 66 percent, and nitrogen loadings by 75 percent. The CRP may generate $3.5 billion to $4 billion in water quality benefits.

Other USDA programs address the safe and efficient use of agricultural chemicals, and their environmental fate. USDA programs have eradicated the boll weevil from Virginia, North Carolina and South Carolina. Programs to foster the use of integrated pest management, integrated crop management, and sustainable agriculture also contribute to reducing the environmental loadings of agricultural chemicals.

The USDA continues to forge new approaches to the abatement of agricultural NPS contamination. The Colorado River Salinity Control Program (CRSCP), begun in 1987, is the prototypical "Watershed Approach" to pollution prevention. This program to reduce salt loadings to the Colorado River helps fulfill U.S. obligations to Mexico for water quality.

Since 1987, the CRSCP has resulted in a salt load reduction of 190,000 tons; and the conservation of some 200,000 acre-feet of water. This has been done at a total USDA cost of $24 million, making the unit costs of salinity reduction about $120 per ton, and of water conservation about $120 per acre-foot.

Compared to removing salinity by reverse osmosis processes, and to the cost of water conservation by other programs, this unheralded program has been a tremendous success.

The USDA and U.S. agriculture continue to address the matters of pesticide or nutrient contamination of the Nation's water resources. But the policy and regulatory communities must address these matters with some sense of reality; to be sure that we are reacting to real (rather than perceived) problems; that we are addressing problems to which agriculture contributes, and for which there are practical solutions, and that prescribed programs will enhance or protect water quality in some demonstrable ways.

The USDA represents the interests of U.S. agriculture, its productivity, and its $18 billion annual positive balance in international trade, and provides leadership for an appropriate balance between efficient agricul-

tural production and the legitimate demands for enhancing and protecting environmental quality.

American farmers are becoming more environmentally sensitive; and they are adopting improved management practices as they become convinced of the desirability to do so. But they can hardly be faulted for a limited response to generic allegations and insupportable estimates of the problems. If a cause-and-effect relationship between their agricultural operations and adverse impacts on water quality can be presented, operators usually can be convinced to make significant changes in their practices. The crucial element is a convincing connection between agricultural practices and water quality. In the case of agricultural NPS contamination, such convincing connections are—by definition—hard to establish.

At the extreme, abandoned farmlands may result in reduced loadings of agricultural NPS pollutants to our Nation's waters. Where they are not simply abandoned, their likely replacements—housing developments, shopping malls, roads and parking lots—may not enhance environmental quality. Where they are abandoned, they will likely be accompanied by increased erosion, eroded tax bases, and infrastructure deterioration.

Pollution prevention is now a topic of conversation everywhere. It is generally acknowledged to be more efficient than treating pollution. There are two associated difficulties: there are no definite end points against which to gauge progress; and it is impossible to prove that prevention is less costly than remediation of something that never happened. The latter point is especially critical in times of tight budgets.

"A government of the people," etc., must set realistic expectations for environmental programs. There are no "no-cost" solutions: the Nation's financial resources are limited; and someone must always pay the bill. NPS pollution is diffuse and hard to identify as to source; and site-specific solutions cannot be applied to generic problems.

CURRENT SITUATION

Composite samples of finished drinking water were collected from locations around Lake Erie, which has the most agricultural watershed of the five Great Lakes, has highly variable tributary flows, and serves as a drinking water supply for a large population. Over the course of the study (3 years), no herbicide in any composite sample exceeded any of its short-term or lifetime Health Advisory Levels. It was concluded that "no significant adverse health effects are to be expected from exposure to herbicides through Lake Erie drinking water."

Data from years of assorted records for several tributaries leading to Lake Erie were analyzed. There were statistically significant reductions in total phosphorus and soluble reactive phosphorus concentrations; nonsignificant downward trends in sediment concentrations, and significant increases in nitrate concentrations in rivers from agricultural watersheds.

Exposures to atrazine through drinking water in Ohio, Illinois, and Iowa were analyzed. Three different approaches to the problem, based on the differing availabilities of data, indicate that there is no documentable human health risk from atrazine ingested through drinking water. The analyses showed that 94 percent of the assessed Ohio population, 97 percent of the assessed Illinois population, and 99 percent of the assessed Iowa population had exposures less than one-third of the lifetime Health Advisory Level.

A widespread well testing program analyzed more than 40,000 samples for nitrate, and more than 10,000 for pesticides. The extent of nitrate and pesticide contamination in rural wells varies considerably from region to region, in response to geologic and hydrogeologic factors and variations in land use. Except in localized problem areas, extreme, high nitrate concentrations are not found in more than 2 percent of the wells, and extreme, high pesticide concentrations are found in fewer than 1 percent of the wells. Over one-half of the samples were free of nitrate, and more than 95 percent were free of herbicides.

The scope of pesticide contamination of Florida's surface waters has been characterized as well. The data from 35 separate agencies, collected over a 12-year period, indicate that a total of 40 pesticides have been detected in surface waters; but that the impact of such sporadic and low levels of detections is below adverse levels.

REMAINING CHALLENGES

While there is no national water quality crisis, some local problems do exist, and need to be addressed. Some of these problems are associated with agricultural production practices. In some cases, appropriate solutions require only the application of known technologies. Most farm-based manure management problems fall into this category.

The storage, handling, and utilization of manures in ecologically sound management systems is no mystery; but the continued intensification of animal production systems without regard to the adequacy of the available land base for manure recycling presents a serious policy problem.

The safeguarding of drinking water supplies from agricultural sources of non-chemical contamination (bacteria, viruses, and parasitic protozoa) requires not only knowledge of the biology of such species and the chemistry of purification, it also requires specific knowledge of the sources of such contamination.

The development of production systems that reduce the introduction of chemicals into the environment presents a continuing challenge. Systems to reduce such introductions are discussed extensively in the proceedings of the conference on "Clean Water-Clean Environment—21st Century," sponsored by the Working Group on Water Quality.

There is a continuing need to develop and deliver programs of education and technical assistance to farmers. Such programs are crucial to the voluntary adoption of improved practices.

It must be remembered that farm audiences are no less dynamic than other populations; and that as conditions change, as production systems change, as world markets change, as technologies change, farmers also change. They must be kept abreast of these changes if they are to compete in world markets, and if they are to contribute to a quality environment.

SUMMARY

• The USDA and American agriculture have made significant progress in reducing the loadings of sediment, pesticides, and nutrients to the Nation's water resources.

• Farmers still respond to incentives, the potential for input cost savings, and environmental concerns.

• USDA programs continue to reduce agricultural NPS contaminant loadings. USDA agencies are providing effective research, education, and technical and financial assistance.

• We are now operating on the relatively flat part of the "response curve," additional increments of water quality will be increasingly difficult and expensive to attain.

• As our Nation develops priorities and goals, the USDA and American agriculture will continue to respond with programs and strategies to achieve safe levels of water quality.

USDA's Water Quality Program: Lessons Learned

Agricultural production often emits pollutants that affect the quality of water resources and impose costs on water users. In 1994 the Environmental Protection Agency reported that agriculture is the leading source of impairment in the Nation's rivers and lakes, and a major source of impairment to estuaries. Agriculture is also an important source of contaminants in some aquifers. The important agricultural pollutants that have been found in water resources include sediment, nutrients, pesticides, salts (from irrigation) and pathogens (from animal waste).

The U.S. Department of Agriculture has implemented several programs for reducing agricultural nonpoint source pollution. These programs rely on voluntary participation by farmers, who are provided education as well as technical and financial assistance for adopting alternative management practices.

In 1990, USDA made a commitment to protect the Nation's waters from contamination by agricultural chemicals and waste products by establishing the Water Quality Program (WQP). This program builds upon past programs such as the Model Implementation Program of the 1970's and the Rural Clean Water Program and Water Quality Special Projects of the 1980's. The Water Quality Program uses education, technical assistance, financial assistance, and research to promote the adoption of alternative management practices for protecting water resources. The WQP strived to: (a) determine the precise nature of the relationship between agricultural activities and water quality; and (b) develop and induce the voluntary adoption of technically and economically effective agrichemical management and agricultural production strategies that protect the beneficial uses of ground and surface water quality.

Experience with these programs has highlighted 10 lessons for enhancing the probability that water quality programs achieve their goals in a cost-effective manner.

1. Cost-effectiveness is enhanced when program activities are targeted to watersheds where agriculture is the primary source of a water quality impairment.

Maximizing program benefits depends on identifying those watersheds where changing farm management strategies will improve water quality, and where the demand for water quality is highest. Watersheds with water quality problems differ greatly in the improvements that can be achieved through changes in agricultural management practices and in the economic benefits of these improvements. Agriculture may not be the primary source of pollutants in an impaired watershed, limiting the degree to which agricultural nonpoint source pollution programs can improve water quality. Point sources, urban runoff, and even natural sources may predominate. The demand for water quality may be very low in some watersheds, due to small population, low economic activity, or an abundance of alternate, high-quality water resources. While water quality may be degraded from the standpoint of aquatic life, scarce program dollars are better spent by first concentrating on those watersheds where the economic benefits from improvements are greatest.

Program cost-effectiveness is enhanced when critical areas for priority treatment within watersheds are identified. Not all farms are the same, differing in proximity to water resources, topography, soils, and management practices. Identifying those critical areas that are likely to contribute disproportionately to a water quality problem greatly increases the effectiveness of assistance.

Identifying critical areas for treatment may be difficult because of the diffuse nature of nonpoint source pollution. However, local personnel may be able to identify such areas based on knowledge of local production practices and resources. Models can also be used to identify critical areas.

2. Voluntary programs are likely to be successful when the alternative practices generate higher returns.

The long-term success of voluntary programs depends on farmers continuing to use new practices after assistance ends. USDA assistance for new practices has typically extended only 1 to 5 years, so practices must be attractive over the long term. The condition that practices both increase net returns and protect the environment limits the set of practices available to address a problem in any project, and on any farm. Some of the practices that protect water quality and that have been shown to be economically attractive include conservation tillage, nutrient management, irrigation water management, and integrated pest management. However, the set of practices that satisfy these conditions for any particular farmer is frequently unknown by program managers.

3. Voluntary programs are likely to be most successful in areas where farmers recognize that agriculture contributes to severe local or on-farm pollution problems such as groundwater impairment.

One of the most important goals of project staff is to convince farmers that the water quality problems in the project are real, and that they are part of the solution. While farmers value environmental quality, they often do not perceive that their actions are affecting local water quality. If farmers perceive a need to alter production practices for reasons other than enhanced profits, the set of practices they might be willing to adopt is increased. Farmers who display some degree of stewardship or altruism towards the environment may be willing to adopt practices that increase their risk or decrease their profits, as long as the local environment benefits and the farm remains financially viable.

4. Flexible financial assistance is more efficient than fixed rates and limited practices.

The availability of financial assistance is a very important part of a successful voluntary program. Even when practices are profitable, constraints to adoption due to increased risk, inexperience with the practice, and other management factors may prevent a farmer from adopting the practice. Financial assistance covers at least part of the risk to farmers of economic losses over the adjustment period, but as currently offered, does not extend over the long term.

A financial assistance program should be flexible in terms of incentive levels and in the practices eligible for assistance. Ideally, the level of assistance for a practice should reflect the expected environmental benefits. This information is often lacking. An alternative strategy is to set rates at levels sufficient to ensure the adoption of practices believed necessary to meet project goals. This rate varies between farmers. Cost-effectiveness is enhanced when differences in the financial and risk characteristics of farmers are considered when offering financial assistance. The determination of eligible practices needs to be made at the project level, with national headquarters playing an oversight role.

5. Project success is enhanced when educational, technical, and financial assistance are offered in a coordinated fashion.

Projects that offer education, technical assistance, and financial assistance have the best chance of promoting alternative production practices. There are a number of constraints to farmers adopting alternative management practices. Not all can be addressed by a single type of assistance. Education can inform producers about new and innovative practices, reduce the cost of obtaining information about practices, and clarify what may be inconsistent and conflicting information about a new practice. Technical assistance reduces a farmer's cost of obtaining information about a practice, helps provide managerial skill that may be lacking, and enables the producer to handle increasingly complex practices. Financial assistance helps overcome a short planning horizon, allows the farmer to accept greater risk over the short run (during the learning phase), and provides an incentive to try something that may be seen as non traditional.

Not all farmers require the full spectrum of assistance, but it should be made available since project staff cannot determine a priori what types of assistance will be needed. Even when regulations provide the impetus for adopting alternative management practices, education and technical assistance are needed to ensure that the new practices are used properly.

6. Local research on the economic and physical performance of recommended practices can improve practice adoption.

Farmers are skeptical of practices that do not have a local history of use. This becomes a problem when new and innovative practices are promoted to address a local water quality problem. Where local experience is lacking, field testing and demonstrations of new practices should be implemented to investigate the economic, environmental, and agronomic features of promoted practices.

7. Interaction with non-USDA agencies, organizations, and local businesses within a watershed is important.

Local environmental and resource districts such as soil and water conservation districts, drainage districts, irrigation districts, and natural resource districts may be operating in project areas. These groups and local business and environmental groups may have some interest in water quality issues. Involving these stakeholders early in project planning would minimize future conflicts, and may bring in additional resources and expertise. Involving local stakeholders has been a particular strength of Water Quality Program projects.

8. More attention to water quality monitoring and project evaluation could help determine the cost-effectiveness of alternative practices and assist in the development of targeting strategies.

Ongoing performance evaluations should be an integral part of every project. Progress assessment can identify problem areas in time for corrective action, and improve targeting criteria for future projects. Water quality monitoring is the most defensible means for evaluating whether a water quality project achieves its goal. An effective monitoring program must establish a baseline of water quality conditions and be maintained long enough to account for lags in the movement of agricultural pollutants and natural fluctuations in weather.

An acceptable alternative to monitoring may be water quality modeling. A number of models that can predict pollutant loadings at the watershed level have become available. Models are useful when prolonged lags in observable water quality improvements are expected. In addition, models can be used to identify critical areas within watersheds and to establish project implementation goals. A drawback of models is that they must be carefully calibrated to local conditions.

In addition to water quality monitoring, an effective mechanism for tracking changes in crop management in the project area must be implemented. Such information enables interim assessments of whether program goals are being achieved, and where and what types of additional assistance might be needed. Just as for water quality, a land management baseline must be established. In order to properly evaluate what is happening in a watershed, it is also necessary to track management changes on those fields not receiving assistance.

9.Water quality programs need to have a long-term focus.

The physical processes that link production practices to water quality, and the socio-economic processes that characterize adoption can both be of long duration. The adoption process, from first learning about a practice through implementation, can take years. While assistance is designed to speed up this process, overall progress can still be slow. Therefore, adequate resources must be made available for an extended period of time to ensure successful completion of the project.

The physical processes that connect on-field management changes to downstream changes in water quality also may take years, and even decades. Water quality

monitoring should be maintained beyond the time assistance ends, and realistic expectations should be set as to when observed improvements in water quality are likely to be seen. Adequate time must also be set aside for pre-implementation planning, including the establishment of baselines and conducting field research on the performance characteristics of alternative practices. Water Quality Program projects were set up as 5-year projects. This time was found to be inadequate, and most projects have been extended for an additional 3 years.

10. Voluntary programs are enhanced if firm but flexible regulations are in the background.

Despite the onerousness of regulations to many in the farm community, they can play an important role in promoting alternative production practices without placing overly burdensome costs on farmers. Voluntary approaches supported by regulatory capabilities may be the most effective means of reducing pollution from agricultural sources. Regulations clarify goals, and provide impetus for farmers to search for alternatives that may in fact maintain or even enhance net returns. Regulations may even be favored by farmers if the efforts of conscientious farmers are recognized and "bad actors" are punished.

Future

The lessons learned from the WQP and past USDA water quality programs provide important guidance for future programs. The new Environmental Quality Incentive Program (EQIP) that was established in the Federal Agriculture Improvement and Reform (FAIR) Act of 1996 will continue the course set by the Water Quality Program. This Act gives USDA a 17-year commitment for providing education, technical, and financial assistance in targeted watershed projects. Many of the recommendations outlined above were incorporated in the enabling legislation, including targeting, increased and flexible financial assistance, a full range of education, technical, and financial assistance, and an emphasis on evaluation and cost effectiveness.

The experience and knowledge from the Water Quality Program will improve the performance of water quality projects based on voluntary adoption of alternative management practices. While the voluntary approach probably cannot by itself achieve all national water quality objectives, it can be a valuable tool to State and Federal water quality protection programs.

Management Systems Evaluation Areas (MSEA) Projects and Agricultural Systems for Environmental Quality (ASEQ) Projects

There is increasing public concern about the quality of our environment and our land, air, and water resources. The underlying concern is the need to develop a sustainable agricultural production system that is globally competitive with the quality of our basic environmental resources. These concerns are being addressed by refocusing USDA and State Cooperator programs. Leadership for the programs is provided by the Agricultural Research Service (ARS) and the Cooperative State Research, Education, and Extension Service (CSREES).

The Management Systems Evaluation Areas (MSEA) projects were established in 1990 in the Midwest. They focused on groundwater and the impact of agriculture upon the water quality. Three new systems projects funded in 1995 are called Agricultural Systems for Environmental Quality (ASEQ). Some of the MSEA projects are changing focus to the broader objectives of the ASEQ projects. Primary goals are: improve and expand scientific knowledge of agricultural production and the quality and quantity of natural resources, and develop and transfer to users new and improved technologies that are economically efficient and environmentally sound.

The MSEA/ASEQ Water Quality program is producing results that are changing the management of soils and water to sustain profitability and enhance the environment. These programs currently involve 150 research and educational specialists. Since 1990, they have provided over 700 publications, directly impacted 50,000 people, and their efforts have reached over 1 million people through press releases, technical reports, and radio and television coverage. Two major conferences have highlighted the MSEA/ASEQ accomplishments, and two independent symposiums were held in 1997.

Some recent accomplishments include:

In North Carolina, a 7-acre wetland is effectively removing nitrates from the runoff and drainage of a 950-acre watershed during the warm season; a Site-Specific Farming workshop was held at Greensboro, North Carolina, and attracted some 200 participants and several industrial and educational displays have been developed for the ASEQ project.

In Indiana, the Indian Creek and the Little Pine Creek ASEQ watersheds, located near West Lafayette, are providing data from 22 stations to test and calibrate models for water quality management.

Ohio's Lake Erie ASEQ project, along with other State and Federal projects, is making excellent progress in reducing phosphorus loading in two major watersheds that discharge into Lake Erie. Watershed phosphorus budgets indicate that the net annual accumulation of phosphorus in the Maumee watershed has dropped from 23,000 metric tons to 2,600 metric tons. Farmers are no longer applying "buildup" levels of phosphorus to their fields – a major cultural change.

Nebraska's MSEA indicates that irrigated corn can be produced profitably with less water and nitrogen than most farmers apply.

Ohio's MSEA project has identified agricultural systems components that maintain profitability and minimize groundwater impact of farming on the bottomlands of the Scioto Valley.

The Minnesota MSEA reports that recharge, influenced by small differences in landscape elevation, can have a large impact on movement of agrichemicals to groundwater; and that such differences need to be considered in management of sandy landscapes. This provides a direct linkage to precision farming, and to more focused management of croplands in Minnesota, North Dakota, and Wisconsin.

The Mississippi Delta ASEQ reports that the use of weed sensor technology has reduced the amount of herbicide needed for weed control in cotton and soybeans; lake water has been dramatically improved.

Demonstration Projects - Selected Impacts

When USDA's Water Quality Program began, plans were made to implement projects to hasten the adoption of Best Management Practices (BMP's).

Demonstration projects, located in 16 States, were planned to shorten the time necessary for transfer and adoption of new management techniques by farmers. The intent was to speed up the usual time lag between the research plot and the farmer's field.

The 16 demonstration projects were distributed from California to Maryland, and from Florida to Idaho. Some selected highlights of their impacts follow.

In the Mid-Nebraska Demonstration Project:

- 200 of 273 surveyed farmers (73%) indicated that they had reduced nitrogen applications.

- Over 100 farmers indicated an average reduction in nitrogen application of 31 lbs per acre.

- Nutrient management practices have been adopted on 6,000 acres of corn.

- Estimated reductions in nitrogen use are 90 tons per year.

Farmers and ranchers in the Seco Creek Demonstration Project (Texas) have adopted (one or more) recommended BMP's on 80% of their rangeland, 94% of their pasture acreage, and 75% of their cropland.

In Minnesota's Anoka Sand Plain Demonstration Project, 37 producers reduced nitrogen use by 15 lbs per acre on 6,400 acres, for a total reduction of 48 tons of nitrogen in 1996. They also reduced phosphorus applications by 6 lbs per acre on 6,300 acres, for a total reduction of 19 tons.

The Saginaw Bay Demonstration Project (Michigan) identified; 75 abandoned wells, and plugged 54 of them. Some 19,000 acres were soil tested for nitrogen in 1996; the average nitrogen "credit" (i.e., nitrogen that need not be applied as fertilizer) was 51 lbs per acre. Nitrogen fertilizer applications were reduced 485 tons, saving the farmers nearly a quarter of a million dollars.

In Maryland's Monocacy River Watershed Water Quality Demonstration Project, farmers have adopted nitrogen management practices on 11,000 acres, saving 27 lbs per acre of fertilizer nitrogen for a total reduction of 148 tons per vear and a reduction in phosphorus fertilizers of 214 tons per vear. The use of PSNT on 1,000 acres reduced nitrogen applications by 50 lbs per acre - a reduction of 25 tons per year. For the period 1990 through 1996, nitrogen applications were reduced by some 1,400 tons, and phosphorus by some 1,750 tons.

In the South Dakota - Big Sioux Aquifer Demonstration Project, farmers reduced nitrogen applications on 1,500 acres by 6 lbs per acre, reducing nitrogen fertilizer inputs by 4.5 tons in 1996, and by 180 tons for the years 1991 through 1995.

The Sacramento Demonstration Project (California) developed alternative irrigation systems that reduce the discharge of a major rice pesticide in public waterways by 97 percent, and that reduce water use in rice production by 40 percent.

The Northeast Iowa Demonstration Project reports that the average fertilizer-N rate on all corn rotations was 115 lbs per acre in 1993 compared to 174 lbs per acre in 1981. In 1993, nitrogen use was reduced in the basin by nearly 2 million pounds; an average reduction of 5 tons for each of the 200 basin farmers, and an average savings of $1,800 per producer.

Hydrologic Unit Area (HUA) Projects - Selected Impacts

In 1990, HUA projects were initiated in 37 locations, followed by an additional 37 projects in 1991. These projects were planned to hasten the farmer adoption of existing BMP's. The intent was to speed up application of accepted BMP's (as opposed to the new, relatively untested ones in the Demonstration Projects).

Space does not permit a complete listing of impacts; selected ones follow.

The Lake Apopka HUA (Florida) has helped farmers to reduce phosphorus fertilizer applications by some 390 tons; this saved the farmers over $500,000 in fertilizer costs, and reduced input costs by $19 per acre.

Wyoming's Ocean Lake HUA was able to mediate a conflict between the Midvale Irrigation District and the U. S. Fish and Wildlife Service. The subsequent compromise agreement provided for needed repairs to Bull Lake Dam, and avoided the costs (and acrimony) associated with litigation, saving the Irrigation District between $60,000 and $100,000, and implementing needed repairs before failure occurred.

Georgia's Little River - Rooty Creek HUA reduced the use of fertilizer nitrogen by 150 tons, as a result of practices to better manage livestock manures. The project is credited with much of the 55 percent reduction in the phosphorus levels in Lake Sinclair.

In Connecticut's Scantic River HUA, pesticide use was reduced by 74 percent (active ingredient)—more than 4 tons. Pre-side dress nitrogen testing resulted in recommendations for an average nitrogen reduction of 55 lbs per acre on nearly 900 acres, or some 25 tons.

Louisiana's Bayou Queue de Torte HUA has assisted with water management improvements on 80 percent of the rice land in the project area—some 80,000 acres. The most popular BMP is the use of settling ponds that provide 15 days' retention of water from rice fields. This detention reduces sediment loads by up to 60 percent, and increases the dissolved oxygen in the water by 2 to 4 ppm.

In Indiana, the Upper Kankakie River HUA estimates that nitrogen applications were reduced by 100 tons on 10,000 acres in 1996; and that phosphorus applications were reduced by some 160 tons.

Wisconsin's Steven's Point-Plover HUA assisted 32 participating farmers by saving (not applying) 36 tons of nitrogen, 42 tons of phosphorus, and 94 tons of potash.

The Upper North Bosque HUA (in Texas) assisted 40 dairies with manure management, reducing loads to streams, and saving input costs estimated at $107 million over the period 1991-1994. Eleven dairies have adopted water conservation strategies that reduce groundwater use by 154 acre-feet per year.

The Indian Lake, Ohio, HUA has assisted in the adoption of conservation tillage on 82 percent of the watershed's cropland; has installed 255 acres of riparian filterstrips, and has reduced sediment delivery to the lake by nearly 80 percent — over 60,000 tons per year.

Arkansas' "Muddy Fork of the Illinois River" HUA has treated over 70 percent of the cropland in the project area, and reports decreases of fertilizer use (nitrogen, 168 lbs per acre, and phosphorus, 23 lbs per acre; with cumulative reductions of 26,500 tons of nitrogen, and 350 tons of phosphorus.

Nebraska's Elm Creek HUA project reports annual reductions in chemical fertilizer use of 28 tons of nitrogen and 13 tons of phosphorus; and reductions of 200 acre-feet per year of irrigation water. The combined annual savings are estimated at $36,000 per year.

In Arizona, the Casa Grande-Coolidge HUA reports savings of 22,000 acre-feet of irrigation water through improved management practices; and the West Maricopa HUA reports a savings of 5,000 acre-feet.

California's West Stanislaus HUA reports that, after 5 years of project activities, half a million tons of sediment has no offsite impacts; and over 30 thousand acre-feet of irrigation water has been saved.

Data and Evaluation

Objectives:

• To develop, analyze, and report timely and statistically reliable data on the aggregate levels of use and composition of pesticides, fertilizers, and related inputs.

• To analyze the expected environmental improvements and economic effects of a comprehensive program of research, education, and technical assistance for reducing potential water quality problems in agriculture.

• The pesticide data program is conducting 2 data collection efforts.

Chemical Use Surveys—Chemical Use Surveys are being conducted by the National Agricultural Statistics Service and the Economic Research Service in several cycles, covering the major field crops, vegetables, and fruits. The surveys were started because of lack of current, reliable data, concerns over chemical residues affecting ground and surface water, and concerns over chemical residues on food crops.

The surveys provide a data base for trends in usage. Data from the surveys are used to develop statistical estimates of fertilizer and pesticide use on major field crops and to provide a research data base to analyze production inputs and practices associated with chemical applications. These data also significantly contribute to Situation and Outlook reports and other USDA research.

The survey of the major field crops in major producing states is conducted every year. The vegetable chemical use and economic survey, begun in 1990, is conducted semiannually and covers 25-30 vegetable crops. The fruit chemical use survey is conducted semiannually (starting in 1991) and covers 25-30 fruit and nut crops.

Year-to-year changes have occurred in the crops and States which were surveyed. The States selected for the survey are those which represent the largest proportion of the national acreage. These States may change as production shifts among States.

A target sample size is selected for each crop to provide a sufficient number of completed interviews to make State-level, statistically reliable estimates of treated acres and application rates for most commonly used pesticides. Fields for this survey are selected using a multiframe, stratified sampling procedure.

Trained staff conduct personal interviews with farm operators to collect data about the selected field. The interviews are scheduled late in the growing season so that operators can provide information covering the full growing season. Interviews for wheat are generally conducted after. Response frequency is generally over 75 percent.

Data gathered in all the surveys include types, application, timing, and amounts of fertilizer, pesticides, and other chemicals. Data are also obtained on irrigation, cropping, and production practices; and for a subset of sample points, economic information on the farm unit is collected.

In 1993 NASS conducted a survey of subscribers to its chemical use publications. Respondents overwhelmingly indicated that the chemical use reports prepared from the survey data are helpful. Respondents found the data useful for determining trends in chemical use, rates of application, and methods of application. Respondents consider the data to be reliable and useful for making market and policy decisions. Some suggested expanding coverage to additional crops and States, and publishing statistics for infrequently used products.

Chemical use data from each survey are reported in Chemical Usage Reports prepared by NASS. Data from the surveys are also used to support policy research. Survey data have been used in an assessment of cotton production impacts on water quality; the adoption of IPM on field crops, vegetables, fruits and nuts; and an assessment of the commodity program's influence on chemical use in corn production.

Area Study Surveys — The Area Study survey uses a cross-sectional, multiple-frame sampling approach to collect data on chemical use and other production practices for particular geographic areas. These surveys are being conducted in areas where the U.S.

Geological Survey is conducting extensive monitoring, modeling, and assessment of water resources as part of its National Water Quality Assessment (NAWQA) program. Together, this information will enable us to examine the effects on water quality of on-farm agricultural chemical use and production practices. USGS is helping us establish the land use-water quality linkages.

Area Study surveys were carried out in 12 NAWQA study regions. These study regions were selected on the basis of the presence of agricultural cropland, significance of agrichemical use, the presence of soils that leach, and a significant water quality demand. The study areas are: Albemarle-Pamlico Drainage, Central Columbia Plateau, Central Nebraska, Iowa-Illinois, Lower Susquehanna Basin, Mississippi Embayment, San Joaquin-Tulare, Southern Arizona, Southern Georgia, Southern High Plains, Upper Snake River Basin, and White River Basin. ERS and NASS have gathered chemical use and farm practice information to be correlated with soil, land use, water quantity and quality, and other hydrologic data. Some of the data collected include a 3-year land use history, including crop history and planting date, 3-year chemical use history irrigation, tillage, cultivation, and conservation practices, and use of non-chemical practices to control pests.

All of the Area Study surveys have been completed. No new surveys are planned. Survey data are supporting a number of research projects. Data have been used in an economic assessment of nitrogen testing for fertilizer management, in the development of an economic model of the agriculture sector in Nebraska, and in an evaluation of the Water Quality Incentive Projects.

The Water Quality Information Center at the National Agricultural Library

Information is a key ingredient of problem solving. A variety of people—scientists, policy makers, economists, engineers and many others—are working on ways to curb pollution from agriculture. The role of the Water Quality Information Center is to meet the information needs of these people. The ultimate goal is an agricultural system that is productive, profitable, and healthy for people and the environment.

The Water Quality Information Center at the National Agricultural Library (NAL), part of the Agricultural Research Service, is the focal point of NAL's water quality efforts. The center collects, organizes, and communicates the scientific findings, educational methodologies, and public policy issues related to water quality and agriculture.

As the world's largest agricultural library, NAL contains a wealth of agricultural information. The NAL collection—more than 2 million volumes—is an invaluable resource for understanding agricultural issues, including issues related to the environment. The WQIC helps people make use of this resource and also helps NAL strengthen its environmental coverage.

Summary of WQIC/NAL progress/accomplishments since 1990:

• Provided more than 1,200 people with personal assistance in finding water-related information.

• USDA and Environmental Protection Agency personnel, private consultants, university faculty and students, members of environmental groups, and others called on the WQIC to help them in their nonpoint-source pollution work.

• Developed nearly 50 bibliographies on timely water quality issues; these provide researchers with overviews of recent water quality work that they can learn from and build upon.

• Established Enviro-News, an Internet mailing list that keeps its several hundred subscribers informed of the latest environmental happenings.

• Used emerging information technologies to provide efficient access to bibliographies, announcements and other water quality information; initially there was the Water Information Network, a text-only, dial-up computer bulletin board (1990-1995); then came the WQIC Gopher site, still text-only, but on the Internet (1993-1997); now the WQIC World Wide Web site offers easy navigation of water quality information with both text and graphics (1994 to present).

• Developed widely used information tools such as a monthly listing of water-related meetings and calls for papers; a guide to bibliographic databases; and a listing of Internet discussion lists covering water-related topics.

• Published and/or presented six papers on accessing water quality information to increase awareness and get feedback on information availability.

• Collaborated with personnel from NRCS to develop a Constructed Wetlands Bibliography; with the Environmental Protection Agency and CSREES to produce Pesticide Applicator Training Materials: A Bibliography; and with the University of Maryland to make water-quality sections of the National Dairy Database available on the World Wide Web.

• The WQIC has improved NAL's capacity in the water resources area by acquiring, without cost, more than 500 water-related items (reports, videotapes, fact sheets) for addition to the NAL collection; and also has recommended the purchase of more than 1,100 water resource items to improve the collection.

• NAL strengthened AGRICOLA—NAL's database of agricultural literature—in the water resources area by selectively indexing 10 additional water-related journals and adding abstracts to the records of 5 more.

• NAL has added thousands of records related to water resources and agricultural nonpoint-source pollution to the AGRICOLA database.

Epilog

Water Quality Issues

This representation of the USDA's Water Quality Program does not begin to capture the totality of the Program, its interactions with other entities, or its efforts on behalf of both American agriculture and the environment.

A quick glance at the media reports of any week will reveal that the issues associated with water quality continue to capture the public interest. The press continues to report regularly on ag-related water quality issues. Whether the specific topic is *Cryptosporidium* in public water supplies, *Pfiesteria* in tidal waters, or *Hypoxia* in the Gulf of Mexico, agriculture is usually alleged to be a contributing (if not the major) factor.

The WGWQ provides a mechanism to respond to such challenges; to present a Departmental view, to communicate with both our traditional partners and with our environmental partners. The USDA's Water Quality Program continues to provide insight into the actions and reactions from both sectors, and into the nature and scope of the alleged agricultural contributions. More importantly, the existence of the WGWQ as a functioning entity sends a powerful message to both agriculturists and environmentalists—USDA is aware of, and concerned about, the need both to protect the Nation's water resources, and to do so in ways that do not unnecessarily handicap American farmers in the global marketplace.

WGWQ Responses

Cryptosporidium

The WGWQ was instrumental in the development of a positive, pro-active USDA response to the issue of *Cryptosporidium*, a major concern for public water supplies when the delivery system is under duress—as many aging systems are, or may soon be. The outbreak of a major epidemic of *Cryptosporidiosis* in the Milwaukee area led to much concern about the source of the infection. While there were major problems with the water treatment mechanism during the time of the outbreak, there was considerable concern later about the sources of the infectious parasites. Popular opinion laid much of the blame on the presence of dairy farms in the watershed.

The WGWQ was able to focus USDA resources on the need for more research and education. Major increases in efforts to identify sources of the parasite were undertaken. To date, more than 70 species have been identified as vectors of *Cryptosporidium parvum*, the infectious parasite. The USDA also produced a technical videotape on *Crytosporidium and cryptosporidiosis: The parasite and the disease*. More than 600 copies have been distributed to water utilities and educational institutions worldwide. A second videotape is in process, to update the previous material.

Within the USDA, copies were distributed by the Soil Conservation Service (now NRCS), the Agricultural Stabilization and Conservation Service (now FSA), and the Extension Service (now CSREES).

The WGWQ also contracted with Cornell University to produce a lay-language fact sheet on the same topic. The fact sheet has been delivered as camera-ready copy to every State, via the Cooperative Extension System.

Hypoxia

In August 1996, the issue of *Hypoxia* in the Gulf of Mexico was brought to the attention of USDA via a policy-level meeting organized by the EPA. This meeting presented information about the existence of an expanded area of oxygen-depleted water in the western Gulf of Mexico, related to discharge from the Mississippi River system, with serious implications about nitrate-nitrogen associated with Corn-Belt agriculture. It was determined that, while there were (are) no demonstrated cause-and-effect relationships between agriculture and the hypoxic area, there was "compelling evidence" that agriculture (specifically, USDA) should be involved in devising solutions to the problem.

The WGWQ was able to schedule a meeting of repre-

sentatives from the North Central Region, held at the University of Minnesota, in September 1996. This meeting began the mobilization of a response to the *Hypoxia* challenge. Since then, a regional committee has been developed; several position/analysis papers have been produced, and the committee has met with many of the affected parties in a meeting in Baton Rouge, Louisiana, and is sponsoring an international symposium on *Hypoxia*, to be held in Anaheim, California, in October 1997.

The WGWQ also has provided continuing input via the "Interim Working Group on *Hypoxia*" an interagency effort to coordinate efforts among several agencies, and has represented USDA interests in the process. The WGWQ also has represented USDA with a number of interested clientele groups, including: The Fertilizer Institute's Management Conference, Farmland Industries "Ag 21" Program, The (Iowa, Illinois, Indiana and Missouri) Farm Bureau Conference on *Hypoxia*.

Previous products of the WGWQ, notably the publications "Water Quality and Nitrate" and "Nitrate Occurrence in U.S. Waters," are relevant to the issue of *Hypoxia*. These publications have been widely distributed within both agricultural and environmental communities. While the specific issue of *Hypoxia* is new, the issue of nitrogen management in agriculture is not.

While it is likely that some, if not many, farmers can do a better job of managing nitrogen inputs for crop production, it is also important to note that rivers in the Midwest have long carried high loads of nitrate. Successful programs to reduce nitrogen inputs and loadings may well be masked by these indigenous loads, and by the long response times for soil equilibria.

Continuing Activities

The WGWQ collaborates with other departments and agencies to further the programs in water quality on both national and international bases. These include:

• Joint sponsorship with USGS and the American Institute of Hydrology, of major international conferences on water issues. These include most republics of the Commonwealth of Independent States (former components of the USSR). Conferences have been held in Washington, DC (May 1993); and in Tashkent, Uzbekistan (September 1996). A third one is in planning for 1999.

• Joint sponsorship with EPA and the American Water Works Association, of the first international conference on *cryptosporidium*. The initial conference was held in Newport Beach, California (March 1997).

• Joint sponsorship, with the EPA and the International Association for Water Quality, international conferences on "diffuse pollution." Conferences have been held in Chicago (September 1993), and Prague, Czech republic (August 1995). A third meeting is being planned for Edinburgh, Scotland (September 1998).

The WGWQ continues to be involved in a wide range of activities that demonstrate USDA's concern about the quality of the Nation's waters, and about any agricultural contribution to either their quality or their degradation. The WGWQ provides a continuing mechanism to interact with Federal agencies, commodity organizations, and environmental organizations in the identification of problems, the search for solutions, and the development of programs to effect the voluntary adoption of appropriate practices by farmers to protect or enhance the quality of the Nation's waters. As was stated in the Preface, the WGWQ's very existence is a powerful message to both communities that USDA is aware of, and concerned about, the need to protect water quality without unnecessarily handicapping American farmers in the global marketplace.

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This publication was coordinated by *IDEA - Information Development • Expanding Awareness*, a collaborative effort initiated by the North Central Cooperative Extension Services to increase the efficiency and effectiveness of developing, producing, and/or marketing educational products nationwide. Through *IDEA*, the Cooperative Extension System's mission is to encourage and expedite partnership among interested educators in the development and promotion of educational products.

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